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The New England species of Closterium

JOSEPH AUGUSTINE CUSHMAN

With the exception of the very large genera *Cosmarium* and *Staurastrum*, the genus *Closterium* is usually the most noticeable in number of species and individuals of any genus of desmids. Oftentimes pure collections may be obtained of certain species in ditches or small pools. The genus is an interesting one in showing the many changes that may take place in a simple form without a complication of lobes and about a single axis.

In its generalized form *Closterium* consists of an arcuate cell tapering from the middle toward the ends and generally circular in cross-section. Upon this simple plan of structure all the various differences in shape, size, and ornamentation take place. All gradations exist between species in which the axis is a straight line to those in which it forms a semicircle. The cell-wall may be colorless or in older specimens various shades of yellowish or reddish-brown. The surface may be smooth or have delicate striations, costae, or even longitudinal markings made up of a series of granules arranged in a longitudinal manner. The apices of the cell form one of the constant features in the species. In the genus they range from squarely truncate to the finest of acute points or even may be larger than the adjacent portions of the cell. In a few of the species the ends of the cell are drawn out into long colorless setaceous beaks.

There are two distinct groups of *Closterium*, according to the manner of division. In one, the cell divides in the middle and the new halves are of the usual size, the new cells being of practically the same length as the first. In another group, division may take place and then be followed by an elongation of the old cell by the insertion of a median section between the original semi-cells. The limits of this are shown by distinct transverse lines across the cell, each suture really representing a cell division.

The semi-cells each contain a single chloroplast, with longitudinal ridges in most cases ; at the distal end of the chloroplast is a vacuole containing one or more crystals of calcium sulphate in continuous motion. Since the desmids were first known, these granules have been a point of interest.

The zygospores of *Closterium* are usually formed between the parent cells and are free. In certain cases the zygospores are paired but usually single and globose. As a rule the zygospores are smooth but in a few species there are spines. In a few species cruciform or quadrate zygospores are formed and the cells remain attached for some time.

Enough synonymy is given under each species to refer to published figures in accessible works and to straighten out many of the New England records already published. The figures given are camera-lucida drawings from specimens. The figures given by Wolle were in many cases rather too conventionalized to represent clearly the form he had under observation. In all, about fifty species of this genus are now known from New England. Those not previously recorded are indicated by an asterisk. The measurements and short description are based entirely upon observed specimens from New England.

As given here, length means the length of a straight line drawn between the apices — not the length of the axis of the cell. Breadth means the diameter across the middle of the cell; where the cross-section of the cell is elliptical, as it is in some of the straight forms, the greatest diameter is given. Records for which I have seen specimens are followed by an exclamation point. In other cases the author's name is given in parentheses.

It will be noted that many of the species are recorded only from southeastern Massachusetts and Rhode Island. Collections from this region were especially rich in *Closterium*, both in number of species and individuals.

1. CLOSTERIUM CYNTHIA DeNot.

Closterium Cynthia DeNot. Elem. Stud. Desm. Ital. 65, *pl. 7. f. 71.* 1867. — Johnson, Bull. Torrey Club **22**: 291. *pl. 239. f. 3.* 1895. — W. & G. S. West, Brit. Desm. **1**: 113. *pl. 11. f. 1–3.* 1904.

Cells small, about 8–10 times as long as wide, strongly curved, apices obtusely rounded; cell-wall yellow-brown with about 13–16 striae visible across the cell.

Length 140–170 μ; breadth 15.5–19 μ; apices 3.5–4 μ; diameter of zygospore 40–46 μ. (PLATE 3, FIGURES 1, 2.)

NEW HAMPSHIRE: North Woodstock!

MASSACHUSETTS: Reading, with zygospores! Lake Watuppa, Fall River!

*2. CLOSTERIUM MALMEI Borge

Closterium Malmei Borge, Arkiv för Botanik **1**: 79. *pl. 1. f. 21.* 1903.

Cells of medium size, about six times as long as wide, strongly curved, outer margin an arc of 140°, inner margin not tumid but evenly curved throughout, gradually narrowed to the apices, which are slightly dilated, then suddenly attenuated; cell-wall reddish-brown in color, with about 10–12 costae visible across the cell.

Length 250–405 μ; breadth 50–63 μ; apex 11–15.5 μ. (PLATE 3, FIGURES 4, 5.)

MASSACHUSETTS: East Bridgewater! Chilmark (H. C., *no. 663*)!

Our specimens seem to be identical with those of Borge, described from Paraguay as *C. Malmei.*

*3. CLOSTERIUM ARCHERIANUM Cleve

Closterium Archerianum Cleve, in Lund. Nova Acta Reg. Soc. Sci. Upsal. III. **8**: 77. *pl. 5. f. 13.* 1871. — W. & G. S. West, Brit. Desm. **1**: 115. *pl. 11. f. 8–10.* 1904.

Cells of medium size, about ten times as long as wide, strongly curved, narrowing regularly to the apices; cell-wall brown with 8–10 striae visible across the cell.

Length 185–210 μ; breadth 19–22 μ. (PLATE 3, FIGURE 3.)

MASSACHUSETTS: Reading!

4. CLOSTERIUM DIDYMOTOCUM Corda

Closterium didymotocum Corda, Alm. de Carlsbad, 185, 190, 192, 209. *pl. 5. f. 64, 65.* 1835. — Wolle, Desm. U. S. 39. *pl. 8. f. 12, 13.* 1884. — Johnson, Bull. Torrey Club **21**: 286. 1894. — W. & G. S. West, Brit. Desm. **1**: 116. *pl. 12. f. 1–5.* 1904.

Closterium Ensis Cushman, Rhodora **5**: 255. 1903.

Cells large, 9–12 times as long as wide, slightly curved, apices broad, truncated, angles rounded, often slightly recurved; cell-wall yellow-brown, ends with a darker annular thickening, smooth or often delicately striate.

Length 310–560 μ; breadth 25–56 μ; apices 12.5–18.6 μ. (PLATE 3, FIGURE 16; PLATE 5, FIGURE 6.)

MAINE: Orono (*W. West*); Kittery! Mud Pond, Township 6, Range 12!

NEW HAMPSHIRE: Intervale! Mt. Moosilauke!

MASSACHUSETTS: Reading! East Bridgewater! Lake Watuppa, Fall River! Milford Pond, Swansea!

RHODE ISLAND: Nyatt!

This species is recorded among the rare desmids of the United States by L. N. Johnson, but it has been found frequently in New England, as the above records show. It has usually been common in the collections in which it has occurred. The delicate striae are very noticeable on specimens from certain localities. Those from Lake Watuppa and Nyatt had them in the majority of cases.

4*a*. **Closterium didymotocum Johnsonii** (W. & G. S. West) comb. nov.

Closterium Johnsonii W. & G. S. West, Jour. Linn. Soc. **33**: 284. *pl. 16. f. 1, 2.* 1898.

Cells more slender, about 17 times as long as wide, central portion nearly straight with subparallel sides, ends gradually attenuated and slightly curved; apices broad, truncated; ends with the darker annular thickening, yellow-brown, smooth.

Length 357 μ; breadth 21 μ; apices 12 μ.

NEW HAMPSHIRE: Plymouth! (Type, H. J., *no. 655*.)

The type of *C. Johnsonii* now in the collection at Harvard University has been examined carefully. I am not satisfied that the apparent sigmoid character of one semi-cell is more than accidental. The other semi-cell does not show it. The ends have the annular thickenings and the broad truncate apices of *C. didymotocum*. It is more attenuated than the typical and slightly smaller.

5. CLOSTERIUM MACILENTUM Bréb.

Closterium macilentum Bréb. Mém. Soc. Sci. Nat. Cherbourg **4**: 53. *pl. 2. f. 36.* 1856. — Wolle, Desm. U. S. 38. *pl. 6. f. 6.* 1884. — W. & G. S. West, Brit. Desm. **1**: 118. *pl. 12. f. 8–10.* 1904.

Cells of medium size, 25–35 times as long as wide, nearly straight, slightly curved toward the ends, apices obtusely rounded; cell-wall smooth, colorless.

Length 360–527 μ ; breadth 11–16 μ ; apices 4.5–6 μ. (PLATE 3, FIGURE 17.)

NEW HAMPSHIRE : Intervale !

MASSACHUSETTS : Carver's Pond, Bridgewater ! Lake Watuppa, Fall River ! Eastham !

6. CLOSTERIUM ANGUSTATUM Kütz.

Closterium angustatum Kütz. Phyc. Germ. 132. 1845. — Wolle, Desm. U. S. 40. *pl. 6. f. 21.* 1884. — W. & G. S. West, Brit. Desm. **1** : 119. *pl. 12. f. 11–13.* 1904.

Cells of medium size, moderately curved, 10–18 times as long as wide, apices truncately rounded ; cell-wall reddish- or yellowish-brown, ends darker, usually 4 costae visible across the cell.

Length 240 μ ; breadth 20 μ ; apices 15 μ.

MAINE : Orono (*W. West*).

MASSACHUSETTS : Berkshire Mts. (*Wolle*) ; Tewksbury (*Lagerheim*).

RHODE ISLAND : Wainskut Pond, North Providence (*Bailey*).

Although this species has several times been reported from New England, all the New England specimens seen in the material I have examined belong to the following variety, and some of the previously recorded specimens are placed there.

7. CLOSTERIUM ANGUSTATUM CLAVATUM Hastings

Closterium angustatum clavatum Hastings, Am. Month. Micr. Jour. **13** : 155. *pl. 1. f. 7.* 1892. — Johnson, Bull. Torrey Club **22** : 291. *pl. 239. f. 6.* 1895.

Cells larger than the typical, ends tumid and clavate ; cell-wall with 3 or 4 costae visible, often spirally twisted at the apices.

Length 355–650 μ ; breadth 21–34 μ ; apices 15–21 μ. (PLATE 3, FIGURE 12.)

MAINE : Mud Pond, Township 6, Range 12 !

NEW HAMPSHIRE : Hanover (*Edwards*) ; Saco Lake (*Wood*) ; Rochester (*Hastings*) ; North Woodstock !

MASSACHUSETTS : East Bridgewater ! Lake Watuppa, Fall River !

CONNECTICUT : Bridgeport, scarce (*Johnson*).

Wolle describes var. *reticulatum* and var. *decussatum*, both of which evidently apply to the same thing. Just what Wolle had, it is difficult to determine. His specimens were from Mt. Everett, Massachusetts. Collections which I made there in May, 1907, failed to show anything which might suggest these forms.

8. CLOSTERIUM COSTATUM Corda

Closterium costatum Corda, Alm. de Carlsbad, 185, etc. *pl. 5. f. 61–63.* 1834. — Wolle, Desm. U. S. 42. *pl. 6. f. 19.* 1884. — W. & G. S. West, Brit. Desm. **1**: 120. *pl. 13. f. 1–3.* 1904.

Cells of medium size, 7–9 times as long as wide, moderately curved, apices rounded; cell-wall dark yellowish-brown, with 6–8 costae visible across the cell.

Length 215–410 μ; breadth 29–44 μ. (PLATE 3, FIGURE 13.)

MAINE: Orono (*W. West*).

NEW HAMPSHIRE: Pudding Pond, North Conway! Intervale!

MASSACHUSETTS: Amherst (*W. West*); Tewksbury (*Lagerheim*); Lake Quinsigamond, Worcester (*Stone*); Reading! West Bridgewater! Gay Head! Almanac Pond, Nantucket!

8a. CLOSTERIUM COSTATUM WESTII Cushman

Closterium costatum Corda, *forma*, W. & G. S. West, Trans. Linn. Soc. Bot. II. **5**: 237. *pl. 13. f. 23, 24.* 1896.

Closterium costatum Westii Cushman, Rhodora **7**: 114. 1905.

Cells only slightly curved, smaller than the typical, tumid in the middle, apices truncate; cell-membrane punctate between the costae.

Length 230–300 μ; breadth 25–32 μ; apices 10–12 μ. (PLATE 3, FIGURE 14.)

NEW HAMPSHIRE: North Woodstock! Pudding Pond, North Conway!

MASSACHUSETTS: Gay Head, Marthas Vineyard!

9. CLOSTERIUM REGULARE Bréb.

Closterium regulare Bréb. Mém. Soc. Sci. Nat. Cherbourg **4**: 148. *pl. 2. f. 35.* 1856. — W. & G. S. West, Brit. Desm. **1**: 122. *pl. 13. f. 4–6.* 1904.

Cells of medium size, 7–9 times as long as wide, moderately curved, apices truncately or angularly rounded; cell-wall light yellowish-brown, with 10–12 costae visible across the cell.

Length 230–310 μ; breadth 25–37 μ; apices 6.5–9.5 μ. (PLATE 3, FIGURE 15.)

NEW HAMPSHIRE: Intervale!
MASSACHUSETTS: Lake Watuppa, Fall River!
RHODE ISLAND: Nyatt!

10. CLOSTERIUM STRIOLATUM Ehrenb.

Closterium striolatum Ehrenb. Phys. Abh. Akad. Wiss. Berlin **1830**: 68. 1832. — Wolle, F.-W. Alg. U. S. 24. *pl. 55. f. 5–8;* Desm. U. S. 44. *pl. 6. f. 5–8. pl. 7. f. 8, 20.* 1892. — W. & G. S. West, Brit. Desm. **1**: 122. *pl. 13. f. 7–16.* 1904.

Cells of medium size, moderately curved, 8–12 times as long as wide, apices broadly truncate, angles rounded; cell-wall yellowish-brown, with 12–20 striae visible across the cell.

Length 220–375 μ; breadth 19–44 μ; apices 9–12.5 μ. (PLATE 3, FIGURE 10.)

MAINE: Basin Mills and Orono (*Harvey*).

NEW HAMPSHIRE: Saco Lake (*Wood*); Meredith and Plymouth (*Johnson*).

MASSACHUSETTS: Amherst (*W. West*); Lake Quinsigamond, Worcester (*Stone*); near Salem (*Bailey*); Bridgewater! Pondville! South Framingham! Reading! Lake Watuppa, Fall River! Eastham (zygospores)!

10*a*. CLOSTERIUM STRIOLATUM ERECTUM Klebs

Closterium striolatum erectum Klebs, Schrift. Physik.-oekonom. Gesells. Königsberg **22**: 14. *pl. 2. f. 3, 4 b, 4 c, 10.* 1879.

Resembling the typical, but with the median portion straight and the ends abruptly curved.

Length 360 μ; breadth 34 μ. (PLATE 3, FIGURE 11.)

NEW HAMPSHIRE: North Woodstock!

Although this variety may be connected with the typical form, it was very common at this one locality and the typical form was absent.

11. CLOSTERIUM INTERMEDIUM Ralfs

Closterium intermedium Ralfs, Brit. Desm. 171. *pl. 29. f. 2h, 3.* 1848. — W. & G. S. West, Brit. Desm. **1**: 125. *pl. 14. f. 1–5.* 1904.

C. striolatum Ehrenb., var. *intermedium* Cushman, Rhodora **5**: 255. 1903; **7**: 115. 1905.

C. striolatum Ehrenb., var. *elongatum* Cushman, *l. c.* 115. 1905.
C. subdirectum West, Jour. Roy. Micr. Soc. **1889**: 17. *pl. 3. f. 16.* 1889.

Cells of medium size, 11–13 times as long as wide, moderately curved, apices truncate with rounded angles; cell-wall yellowish-brown, with 7–10 striae visible across the cell.

Length 220–370 μ; breadth 19–28 μ; apices 8–11 μ.

MAINE: Kittery!

NEW HAMPSHIRE: Intervale!

MASSACHUSETTS: Amherst (*W. West*); South Framingham! Plainville! Pondville! East Bridgewater! North Watuppa Lake, Fall River! Westport! Swansea!

RHODE ISLAND: Nyatt!

*12. CLOSTERIUM ULNA Focke

Closterium Ulna Focke, Physiologische Studien 59. *pl. 3. f. 30.* 1847.— W. & G. S. West, Brit. Desm. **1**: 127. *pl. 14. f. 7–9.* 1904.

Cells of medium size, about 30 times as long as wide, apices truncate; cell-wall slightly yellow, with 15–20 fine striae visible across the cell.

Length 370 μ; breadth 11.5 μ; apices 7.5 μ. (PLATE 3, FIGURE 9.)

MASSACHUSETTS: Randolph!

The specimens from this locality were very elongate, otherwise they were typical.

13. CLOSTERIUM JUNCIDUM Ralfs

Closterium juncidum Ralfs, Brit. Desm. 172. *pl. 29. f. 6.* 1848. — Wolle, Desm. U. S. 38. *pl. 6. f. 2, 3.* 1884.— W. & G. S. West, Brit. Desm. **1**: 128. *pl. 14. f. 10–14.* 1904.

Cells long and slender, 30–45 times as long as wide, median portion straight and of uniform width, apices slightly curved, obtusely rounded; cell-wall yellowish-brown, with 5–7 striae visible across the cell.

Length 210–375 μ; breadth 6–8.5 μ; apices 3.5 μ. (PLATE 3, FIGURE 18.)

MAINE: Orono (*Harvey*); Kittery!

NEW HAMPSHIRE: Saco Lake (*Wood*); Pudding Pond, North Conway!

MASSACHUSETTS: Lake Quinsigamond, Worcester (*Stone*); South Framingham! Lake Watuppa, Fall River!

* 13*a*. CLOSTERIUM JUNCIDUM ELONGATUM Roy & Biss.

Closterium juncidum elongatum Roy & Biss. Ann. Scot. Nat. Hist. 245. 1894. — W. & G. S. West, Brit. Desm. **1**: 130. 1904.

Cells broader than in the typical form, 26–36 times as long as wide.

Length 310–381 μ; breadth 11.5–12 μ; apices 7 μ.

MASSACHUSETTS: Tewksbury (*Lagerheim*); Lake Watuppa, Fall River!

* 13*b*. CLOSTERIUM JUNCIDUM BREVIUS Roy

Closterium juncidum var. β Ralfs, Brit. Desm. 172. *pl. 29. f. 7.* 1848.

Closterium juncidum β brevior Roy, Jour. Bot. **28**: 336. 1890. — W. & G. S. West, Brit. Desm. **1**: 129. *pl. 14. f. 15, 16.* 1904.

Cells relatively broader than in the typical, 12–15 times as long as wide.

Length 165–210 μ; breadth 12.5–13.5 μ. (PLATE 3, FIGURE 19.)

MASSACHUSETTS: Lake Watuppa, Fall River!

14. CLOSTERIUM DIANAE Ehrenb.

Closterium Dianae Ehrenb. Infusionsth. 92. *pl. 5. f. xvii. 1–6.* 1838. — Wolle, Desm. U. S. 45. *pl. 7. f. 9. pl. 8. f. 4.* 1884. — W. & G. S. West, Brit. Desm. **1**: 130. *pl. 15. f. 1–6.* 1904.

Closterium acuminatum Wolle, Desm. U. S. 44. *pl. 7. f. 18, 19.* 1884.

Cells of medium size, strongly curved, attenuated to the obtusely rounded apices, the dorsal margin of each being obliquely truncated and thickened; cell-wall yellowish-brown, smooth; zygospores spherical.

Length 325–360 μ; breadth 25–31 μ; diameter of zygospores 36–40 μ. (PLATE 4, FIGURE 12.)

MAINE: Orono (*Harvey*, *W. West*); Kittery, frequent!

NEW HAMPSHIRE: Pudding Pond, North Conway!

MASSACHUSETTS: Amherst (*W. West*); Lake Quinsigamond, Worcester (*Stone*); Mt. Everett (*Wolle*); Bridgewater! Reading, (zygospores)!

RHODE ISLAND: Wainskut Pond, North Providence (*Bailey*).

The obliquely truncated and thickened dorsal margin of the apices is very characteristic.

* 14*a*. CLOSTERIUM DIANAE ARCUATUM (Bréb.) Rabenh.

Closterium arcuatum Bréb. in Ralfs, Brit. Desm. 219. 1848.

Closterium Dianae arcuatum Rabenh. Flor. Europ. Alg. **3**: 133. 1868. — Wolle, Desm. U. S. *pl. 7. f. 8.* 1884. — W. & G. S. West, Brit. Desm. **1**: 131. *pl. 15. f. 21, 22.* 1904.

Slightly smaller and more strongly curved than in the typical form, about 10 times as long as wide.

Length 190 μ; breadth 19 μ.

MASSACHUSETTS: Cedar Pond, North Falmouth!

* 15. CLOSTERIUM PSEUDODIANAE Roy

Closterium Pseudodianae Roy, Scottish Naturalist **10**: 201. 1890. — W. & G. S. West, Brit. Desm. **1**: 132. *pl. 15. f. 7, 8.* 1904.

Cells of medium size, moderately curved, 15–20 times as long as wide, apices narrow and obtuse; cell-wall colorless or light yellowish-brown, smooth.

Length 155–254 μ; breadth 11.5–12.5 μ; apices 2.5–3 μ. (PLATE 5, FIGURE 1.)

MASSACHUSETTS: North Lake Watuppa, Fall River! Cedar Pond, North Falmouth!

RHODE ISLAND: Nyatt!

This species is narrower and less curved than *C. Dianae* but is not nearly so common. It has not previously been reported from the United States.

16. CLOSTERIUM PARVULUM Näg.

Closterium parvulum Näg. Gatt. einz. Alg. 106. *pl. 6 C. f. 2* (in part). 1849. — Wolle, Desm. U. S. 45. *pl. 7. f. 7. pl. 8. f. 16.* 1884. — W. & G. S. West, Brit. Desm. **1**: 133. *pl. 15. f. 9–12.* 1904.

Closterium calosporum Cushman, Rhodora **7**: 115. 1905.

Cells small, strongly curved, 10–12 times as long as wide, apices acutely rounded; cell-wall colorless, smooth.

Length 108–170 μ; breadth 10–15 μ; apices 1.5–2.3 μ. (PLATE 3, FIGURES 6, 7.)

MAINE: Orono (*Harvey*); Mud Pond, Township 6, Range 12!

NEW HAMPSHIRE: Pudding Pond, North Conway!

MASSACHUSETTS: Amherst (*W. West*); Lake Quinsigamond, Worcester (*Stone*); South Framingham! Medford!

In the absence of zygospores, the *C. calosporum* reported from North Conway, N. H. is included here.

17. CLOSTERIUM JENNERI Ralfs

Closterium Jenneri Ralfs, Brit. Desm. 167. *pl. 28. f. 6.* 1848. — Wolle, Desm. U. S. 44. *pl. 7. f. 5.* 1884. — W. & G. S. West, Brit. Desm. **1**: 134. *pl. 15. f. 23–25.* 1904.

Cells small, strongly curved, especially toward the ends, the middle portion nearly straight, apices obtusely rounded; cell-wall colorless, smooth.

Length 40–75 μ; breadth 6–10 μ. (PLATE 5, FIGURES 3, 4.)

MAINE: Mud Pond, Township 6, Range 12!

MASSACHUSETTS: Amherst (*W. West*); Lake Quinsigamond, Worcester (*Stone*); Misery Island, off Beverly, rare! Lake Watuppa, Fall River!

RHODE ISLAND: Wainskut Pond, North Providence (*Bailey*); Portsmouth! Nyatt!

18. CLOSTERIUM INCURVUM Bréb.

Closterium incurvum Bréb. Mém. Soc. Sci. Nat. Cherbourg **4**: 150. *pl. 2. f. 47.* 1856. — W. & G. S. West, Brit. Desm. **1**: 136. *pl. 15. f. 28–30.* 1904.

Cells very small, strongly curved, 5–6 times as long as wide, apices acute; cell-wall colorless, smooth.

Length 62–68 μ; breadth 11–12 μ. (PLATE 3, FIGURE 8.)

NEW HAMPSHIRE: Intervale!

MASSACHUSETTS: Reading! Gibbs and Almanac Ponds, Nantucket!

19. CLOSTERIUM VENUS Kütz.

Closterium Venus Kütz. Phyc. Germ. 130. 1845. — Wolle, Desm. U. S. 44. *pl. 7. f. 6.* 1884. — W. & G. S. West, Brit. Desm. **1**: 137. *pl. 15. f. 15–20.* 1904.

Cells small, strongly curved, 8–9 times as long as wide, apices acute; cell-wall colorless and smooth.

Length 56–87 μ; breadth 7–10.5 μ. (PLATE 5, FIGURE 2.)

MAINE: Oldtown (*Harvey*); Kittery!

NEW HAMPSHIRE: Bog near Noone's Station! Mt. Moosilauke, common!

MASSACHUSETTS: Amherst (*W. West*); Winchester! Reading! Wellesley! Wakefield! Lake Watuppa, Fall River! Westport! Cedar Pond, North Falmouth! Nantucket!

RHODE ISLAND: Nyatt!

This is one of our commoner species.

20. CLOSTERIUM EBORACENSE Turner

Closterium eboracense Turner, in Cooke, Brit. Desm. 37. *pl. 65. f. 1.* 1886. — W. & G. S. West, Brit. Desm. **1**: 140. *pl. 16. f. 7, 8.* 1904.

Closterium Cucumis Wolle (non Ehrenb.), Desm. U. S. 40. *pl. 6. f. 17, 18.* 1884.

Cells of medium size, 5–6 times as long as wide, outer margin strongly curved, inner margin very slightly concave, apices bluntly rounded; cell-wall colorless and smooth.

Length 248–325 μ; breadth 48–50 μ.

MAINE: Oldtown and Orono (*Harvey*).

MASSACHUSETTS: Amherst (*W. West*); Stony Brook, Weston! Gay Head, Marthas Vineyard!

The specimens reported from America as *C. Cucumis* are as a rule *C. eboracense*, as the work of Wolle was followed by many writers.

21. CLOSTERIUM LEIBLEINII Kütz.

Closterium Leibleinii Kütz. Linnaea 8: 596. *pl. 18. f. 79.* 1834. — Wolle, Desm U. S. 46. *pl. 7. f. 13, 14, 20.* 1884. — W. & G. S. West, Brit. Desm. **1**: 141. *pl. 16. f. 9–14.* 1904.

Cells of medium size, strongly curved, 5–6 times as long as wide, apices acutely rounded; cell-wall colorless and smooth.

Length 112–190 μ; breadth 18–34 μ. (PLATE 4, FIGURE 9.)

MAINE: Orono (*W. West*); Kittery!

MASSACHUSETTS: Amherst (*W. West*); South Framingham! Winchester! Myricks! East Bridgewater! Cedar Pond, North Falmouth! Eastham, abundant! Nantucket!

RHODE ISLAND: near Providence (*Bailey*); Nyatt!

22. CLOSTERIUM MONILIFERUM (Bory) Ehrenb.

Lunulina monilifera Bory, Encycl. Meth. Hist. Zooph. **2**: 501. *pl. 3. f. 22, 25, 27.* 1824.

Closterium moniliferum Ehrenb. Infus. 91. *pl. 5. f. 16* (in part). — Wolle, Desm. U. S. 45. *pl. 7. f. 15.* 1884. — W. & G. S. West, Brit. Desm. **1**: 142. *pl. 16. f. 15, 16.* 1904.

C. Leibleinii Kütz., var. *curtum* West, Jour. Roy. Micr. Soc. **1889**: 17. *pl. 2. f. 8.* 1889.

Cells larger than in the preceding, stout, moderately curved, about 6 times as long as wide, apices obtusely rounded; cell-wall colorless and smooth.

Length 200–325 μ; breadth 31–56 μ. (PLATE 4, FIGURE 10.)

MAINE: Orono (*Harvey*); Gorham (*W. West*); Bridgeton! Spencer Pond, East Middlesex!

NEW HAMPSHIRE: Intervale!

MASSACHUSETTS: Reading! Wakefield! Pondville! Halifax! Lake Watuppa, Fall River! Gay Head, Marthas Vineyard! Nantucket!

RHODE ISLAND: Wainskut Pond, North Providence (*Bailey*).

23. CLOSTERIUM EHRENBERGII Menegh.

Closterium Ehrenbergii Menegh. Linnaea **14**: 232. 1840.—Wolle, Desm. U. S. 45. *pl. 7. f. 16.* 1884.— W. & G. S. West, Brit. Desm. **1**: 143. *pl. 17. f. 1–4.* 1904.

C. robustum Hastings, Am. Month. Micr. Jour. **13**: 154. *pl. 1. f. 4.* 1892.

Cells large, stout, moderately curved, about 4 times as long as wide, apices obtusely rounded; cell-wall colorless and smooth.

Length 400–480 μ; breadth 78–125 μ. (PLATE 4, FIGURE 11.)

MAINE: Near Penobscot River at Great Works and Orono (*Harvey*); Mud Pond, Township 6, Range 12!

NEW HAMPSHIRE: Page Brook, Rochester (*Hastings*).

MASSACHUSETTS: Amherst (*W. West*); Lake Quinsigamond, Worcester (*Stone*); Bridgewater! Watuppa, Fall River! Eastham!

24. CLOSTERIUM ACEROSUM (Schrank) Ehrenb.

Vibrio acerosus Schrank, Fauna Boica **3^2**: 47. *no. 2848.* 1803.

Closterium acerosum Ehrenb. Symb. Phys. Phytozoa, *pl. 2. f. 9.* 1828; Infus. 93. *pl. 2. f. 15. pl. 6. f. 1. pl. 22. f. 5.* 1838.

— Wolle, Desm. U. S. 41. *pl. 6. f. 7, 11. pl. 8. f. 17.* 1884. — W. & G. S. West, Brit. Desm. **1** : 146. *pl. 18. f. 2–5.* 1904.

Cells large, elongate, only slightly curved, about 10–12 times as long as wide, gradually tapering to the narrow rounded-truncate apices ; cell-wall usually colorless and smooth but in old specimens the cell-wall becomes brownish, sometimes finely striate and the apices thickened just back from the tips.

Length 355–480 μ ; breadth 33–42 μ.

MAINE : Orono (*Harvey, W. West*) ; Mud Pond, Township 6, Range 12 !

NEW HAMPSHIRE : Intervale !

MASSACHUSETTS : Lake Quinsigamond, Worcester (*Stone*) ; Tewksbury (*Lagerheim*) ; Stony Brook, Weston ! Carvers Pond, Bridgewater ! Eastham !

24*a*. CLOSTERIUM ACEROSUM ELONGATUM Bréb.

Closterium acerosum, var. *elongatum* Bréb. *l. c.* 152. 1856. — W. & G. S. West, Brit. Desm. **1** : 148. *pl. 18. f. 1.* 1904.

Longer and larger than the typical form ; cell-wall yellowish-brown with more distinct striations.

Length 500–651 μ ; breadth 37–54 μ. (PLATE 4, FIGURE 6.)

MASSACHUSETTS : Amherst (*W. West*) ; Medford ! Lake Watuppa, Fall River ! Nantucket !

25. CLOSTERIUM LANCEOLATUM Kütz.

Closterium lanceolatum Kütz. Phyc. Germ. 130. 1845. — Wolle, Desm. U. S. 39. *pl. 8. f. 14.* 1884. — W. & G. S. West, Brit. Desm. **1** : 149. *pl. 17. f. 9, 10. pl. 18. f. 7.* 1904.

Cells large 4½–7 times as long as wide, nearly straight, outer margin slightly curved, inner margin often slightly convex, gradually attenuated to the acutely rounded apices ; cell-wall colorless, smooth.

Length 390–415 μ ; breadth 70–93 μ.

VERMONT : Lake Champlain !

MASSACHUSETTS : Amherst (*W. West*) ; South Framingham !

RHODE ISLAND : Nyatt !

26. CLOSTERIUM LUNULA (Müll.) Nitzsch

Vibrio Lunula Müll. Naturforsch. **20** : 142. 1784.

Closterium Lunula Nitzsch, Neue Schrift. Nat. Gesells. Halle **3** : 60,

67. 1817. — Wolle, Desm. U. S. 40. *pl. 50. f. 26.* 1884. — W. & G. S. West, Brit. Desm. **1**: 150. *pl. 18. f. 8, 9.* 1904.

Cells large, stout, 6–7 times as long as wide; axis nearly straight, outer margin curved, inner margin nearly straight, or slightly tumid in the middle, becoming somewhat concave toward the ends, apices often slightly recurved, obtusely rounded; cell-wall colorless, smooth.

Length 465–650 μ; breadth 71–93 μ; apices 12–15 μ. (PLATE 4, FIGURE 18.)

MAINE: Oldtown and Great Works (*Harvey*).

NEW HAMPSHIRE: Pudding Pond, North Conway, common! North Woodstock!

MASSACHUSETTS: Amherst (*W. West*); near Salem (*Bailey*); Misery Island, off Beverly! Reading! Gay Head, Marthas Vineyard!

RHODE ISLAND: Nyatt!

Wolle's figure of this species is not a good one, as he notes.

26*a*. CLOSTERIUM LUNULA INTERMEDIUM Gutw.

Closterium Lunula, var. *intermedium* Gutw. Rozpraw. Wydz. matem.-przyr. Akad. Umiej. Krakow. **32**: 39. *pl. 6. f. 17.* 1897. — W. & G. S. West, Brit. Desm. **1**: 152. *pl. 18. f. 12.* 1904.

Cells with the outer margin more convex, the inner margin broadly convex, ends abruptly narrowed to the truncate apices.

Length 440–540 μ; breadth 65–94 μ.

MASSACHUSETTS: Lake Watuppa, Fall River! Gibbs Pond, Nantucket!

26*b*. CLOSTERIUM LUNULA MINUS W. & G. S. West

Closterium Lunula, forma *minor* W. & G. S. West, Brit. Desm. **1**: 151. 1904.

Smaller than the typical form; the cell-wall faintly straw-colored.

Length 403 μ; breadth 56 μ.

NEW HAMPSHIRE: Intervale!

* 26*c*. CLOSTERIUM LUNULA MAXIMUM Borge

Closterium Lunula, var. *maximum* Borge, Arkiv för Botanik **1**: 77. *pl. 1. f. 9.* 1903.

Cells very large, about four times as long as wide, slightly concave close to the apices, dorsal margin broadly convex, ventral margin slightly tumid.

Length 800 μ; breadth 170 μ. (PLATE 5, FIGURE 7.)

MASSACHUSETTS: Milford Pond, Swansea!

This is one of the largest of our desmids and is visible without a lens.

* 27. CLOSTERIUM LITTORALE Gay

Closterium littorale Gay, Monogr. Conj. 75. *pl. 2. f. 17.* 1884. — W. & G. S. West, Brit. Desm. **1**: 155. *pl. 19. f. 14.* 1904.

Cells rather small, about nine times as long as wide, slightly curved, inner margin tumid in the middle, gradually attenuated to the obtusely rounded apices; cell-wall colorless, smooth; zygospore globose and smooth.

Length 160–164 μ; breadth 18–18.5 μ; diameter of zygospore 28 μ. (PLATE 4, FIGURE 8; PLATE 5, FIGURE 12.)

MASSACHUSETTS: Eastham, with zygospores!

This is the first record for the zygospore of this species. New to United States.

28. CLOSTERIUM TUMIDUM Johnson

Closterium tumidum Johnson, Bull. Torrey Club **22**: 291. *pl. 239. f. 4.* 1895. — W. & G. S. West, Brit. Desm. **1**: 156. *pl. 19. f. 15–18.* 1904.

Closterium Cornu, forma *major* West, Jour. Bot. 339. 1888.

Cells rather small, 8–9 times as long as wide, slightly curved, inner margin prominently tumid in the middle, gradually attenuated to the truncately rounded apices; cell-wall colorless, smooth.

Length 130–150 μ; breadth 14–18 μ.

MAINE: Orono (*W. West*).

NEW HAMPSHIRE: Holderness, frequent (*Johnson, W. & G. S. West*); Pudding Pond, North Conway!

29. CLOSTERIUM ABRUPTUM West

Closterium abruptum West, Jour. Roy. Micr. Soc. **1892**: 719. *pl. 9. f. 1.* 1892. — Johnson, Bull. Torrey Club **22**: 291. *pl. 239. f. 5.* 1895. — W. & G. S. West, Trans. Linn. Soc. Bot. II. **5**: 236. *pl. 13. f. 14, 15.* 1896; Brit. Desm. **1**: 158. *pl. 20. f. 6–10.* 1904.

Cells rather small, about 12 times as long as wide, slightly curved, median portion nearly straight, ends more curved, gradually attenuated to the broadly truncate apices; cell-wall colorless or slightly yellowish-brown, smooth.

Length 84–200 μ; breadth 12.5–15.5 μ; apices 6 μ.

MAINE: Orono (*W. West*).

NEW HAMPSHIRE: Holderness, frequent (*Johnson*).

MASSACHUSETTS: Gibbs Pond, Nantucket!

*30. CLOSTERIUM TOXON West

Closterium toxon West, Jour. Linn. Soc. Bot. **19**: 121. *pl. 19. f. 14.* 1892. — W. & G. S. West, Brit. Desm. **1**: 160. *pl. 20. f. 13, 14.* 1904.

Cells linear, 25 or more times as long as wide, straight with nearly parallel margins, except toward the ends, which are slightly curved, apices subtruncate; cell-wall colorless or a light yellowish-brown, smooth.

Length 242–365 μ; breadth 9–12 μ; apices 4.5–8 μ. (PLATE 4, FIGURE 17.)

MASSACHUSETTS: Lake Watuppa, Fall River! Cedar Pond, North Falmouth!

*31. CLOSTERIUM PRAELONGUM Bréb.

Closterium praelongum Bréb. *l. c.* 152. *pl. 2. f. 41.* 1856. — Wolle (?), F.-W. Alg. U. S. 24. *pl. 55. f. 15, 16.* 1887. — Desm. U. S. 43. *pl. 6. f. 15, 16.* 1892. — W. & G. S. West, Brit. Desm. **1**: 164. *pl. 21. f. 1, 2.* 1904.

Cells very elongate, about 35 times as long as wide, very gently curved, inner margin slightly concave for its entire length, gradually attenuated to the somewhat recurved ends, apices obtuse; cell-wall colorless, smooth.

Length 520 μ; breadth 14 μ; apex 5 μ.

MASSACHUSETTS: Lake Watuppa, Fall River!

Wolle figures a striate form with colored cell-wall under this name. The breadth given is rather large also for this species.

32. CLOSTERIUM STRIGOSUM Bréb.

Closterium strigosum Bréb. *l. c.* 153. *pl. 2. f. 43.* 1856. — Wolle, Desm. U. S. 42. *pl. 6. f. 13, 14. pl. 53. f. 9, 10.* 1884. — W. & G. S. West, Brit. Desm. **1**: 165. *pl. 21. f. 6, 7.* 1904.

Cells of medium size, 12–18 times as long as wide, slightly curved, nearly straight in the middle with the ends more curved, apices subacute; cell-wall colorless, smooth.

Length 170–294 μ; breadth 13–16 μ.

MAINE: Orono (*Harvey*).

NEW HAMPSHIRE: Pudding Pond, North Conway!

MASSACHUSETTS: Amherst (*W. West*); Winchester!

33. CLOSTERIUM GRACILE Bréb.

Closterium gracile Bréb. in Cheval. Microscop. 272. 1839. — Wolle, Desm. U. S. 39. *pl. 6. f. 4, 5.* 1884. — W. & G. S. West, Brit. Desm. **1**: 166. *pl. 21. f. 8–12.* 1904.

C. subtile Harvey, Bull. Torrey Club **19**: 121. 1892. — Cushman, Rhodora **5**: 252. 1903.

Cells small, linear, about 40 times as long as wide, median portion straight with parallel margins, ends gradually attenuated and somewhat curved, apices obtuse; cell-wall colorless and smooth.

Length 172–264 μ; breadth 5–6.2 μ; apices 2.8 μ.

MAINE: Orono (*W. West, Harvey*).

MASSACHUSETTS: Lake Watuppa, Fall River! Misery Island, off Beverly!

RHODE ISLAND: Nyatt!

* 33*a*. CLOSTERIUM GRACILE ELONGATUM W. & G. S. West

Closterium gracile var. *elongatum* W. & G. S. West, Brit. Desm. **1**: 168. *pl. 21. f. 14–16.* 1904.

Cells very elongate, over 100 times as long as wide, otherwise much like the typical.

Length 355 μ; breadth 3.2 μ; apices 1.8 μ.

MASSACHUSETTS: Cedar Pond, North Falmouth!

* 33*b*. CLOSTERIUM GRACILE TENUE (Lemm.) W. & G. S. West

Closterium limneticum Lemm., var. *tenue* Lemm. Phytoplankton Sächsis. Teiche 28. *pl. 2. f. 42–44.* 1899.

C. gracile, var. *tenue* W. & G. S. West, Trans. Linn. Soc. Bot. II. **6**: 138. *pl. 18. f. 22, 23.* 1902; Brit. Desm. **1**: 168. *pl. 21. f. 13.* 1904.

Cells smaller and more slender than in the typical form of the species.

Length 78 μ; breadth 3 μ.

MASSACHUSETTS: Reading!

34. CLOSTERIUM ATTENUATUM Ehrenb.

Closterium attenuatum Ehrenb. Infus. 94. *pl. 6. f. 4.* 1838. — Wolle, Desm. U. S. 41. *pl. 8. f. 5.* 1884. — W. & G. S. West, Brit. Desm. **1**: 169. *pl. 22. f. 1–3.* 1904.

Cells large, about 11 times as long as wide, slightly curved, gradually attenuated toward the ends, where they are suddenly contracted into the obtusely rounded apices; cell-wall reddish-brown in color, with about 20 striae visible across its surface.

Length 465 μ; breadth 45 μ.

MAINE: Frog Pond, Orono (*Harvey*).

NEW HAMPSHIRE: Pudding Pond, North Conway!

35. CLOSTERIUM TURGIDUM Ehrenb.

Closterium turgidum Ehrenb. Infus. 95. *pl. 6. f. 7.* 1838. — Wolle, Desm. U. S. 41. *pl. 6. f. 15.* 1884. — W. & G. S. West, Brit. Desm. **1**: 170. *pl. 22. f. 4, 5.* 1904.

Cells large, somewhat curved, about 13 times as long as wide, ends recurved, apices subtruncate; cell-wall reddish-brown, with 30 or more fine striations visible across the surface.

Length 682 μ; breadth 53 μ; apices 12 μ.

MAINE: Orono (*W. West*).

MASSACHUSETTS: Near Salem (*Bailey*); Lake Watuppa, Fall River!

RHODE ISLAND: Providence (*Bailey*).

* 36. CLOSTERIUM PRITCHARDIANUM Arch.

Closterium Pritchardianum Arch. Proc. Dubl. Nat. Hist. Soc. $\mathbf{3}^2$: 250. *pl. 12. f. 25–27.* 1862. — W. & G. S. West, Brit. Desm. **1**: 172. *pl. 22. f. 6–14.* 1904.

C. turgidum, forma *intermedium* Cushman, Rhodora **7**: 116. 1905.

Cells large, only slightly curved, about 15 times as long as wide, inner margins nearly straight, ends slightly recurved, apices truncate; cell-wall reddish-brown, with nearly 40 striae, composed of punctae across the surface.

Length 400 μ; breadth 28 μ; apices 7–9 μ. (PLATE 4, FIGURE 5.)

NEW HAMPSHIRE: Intervale!

37. CLOSTERIUM PRONUM Bréb.

Closterium pronum Bréb. Mém. Soc. Sc. Nat. Cherbourg **4**: 157. *pl. 2. f. 42.* 1856. — Wolle, F.-W. Alg. U. S. 25. *pl. 55. f. 22.*

1887; Desm. U. S. 50. *pl. 6. f. 22.* 1892.—W. & G. S. West, Brit. Desm. **1**: 173. *pl. 23. f. 1–3.* 1904.

Cells very elongate, about 50 times as long as wide, nearly straight, very gradually attenuated to the narrow but obtuse apices; cell-wall colorless or slightly yellowish-brown, smooth or with traces of a fine striation in the older specimens.

Length 320–375 μ; breadth 6–8.5 μ.

MAINE: Orono (*W. West*).

NEW HAMPSHIRE: Pudding Pond, North Conway!

*38. CLOSTERIUM ACICULARE T. West

Closterium aciculare T. West, Trans. Roy. Micr. Soc. **8**: 153. *pl. 7. f. 16.* 1860.—W. & G. S. West, Brit. Desm. **1**: 174. *pl. 26. f. 18, 19.* 1904.

Cells very elongate, 76 times as long as wide, median portion straight, ends somewhat incurved, attenuated very gradually to the acutely rounded apices; cell-wall colorless, smooth.

Length 380 μ; breadth 5 μ. (PLATE 4, FIGURE 7.)

MASSACHUSETTS: Lake Watuppa, Fall River!

Not previously reported from the United States.

39. CLOSTERIUM ACUTUM (Lyngb.) Bréb.

Echinella acuta Lyngb. Hydr. Dan. 209. *pl. 69. f. G.* 1819.

Closterium acutum Bréb. in Ralfs, Brit. Desm. 177. *pl. 30. f. 5. pl. 34. f. 5, a, b, d–f.* 1848.—Wolle, Desm. U. S. 44. *pl. 7. f. 11, 12.* 1884.—W. & G. S. West, Brit. Desm. **1**: 177. *pl. 23. f. 9–14.* 1904.

Cells small, about 25 times as long as wide, somewhat curved, inner margin not tumid, gradually attenuated to the acute apices; cell-wall colorless, smooth.

Length 150 μ; breadth 6 μ. (PLATE 5, FIGURE 11.)

MAINE: Orono (*W. West*).

MASSACHUSETTS: Amherst (*W. West*); Weston (*W. & G. S. West*); Reading!

*40. CLOSTERIUM SUBULATUM (Kütz.) Bréb.

Frustularia subulata Kütz. Syn. Diat. 538. *pl. 13. f. 1.* 1834.

Closterium subulatum Bréb. in Cheval. Microscop. 272. 1839. —W. & G. S. West, Brit. Desm. **1**: 179. *pl. 23. f. 16–19.* 1904.

Cells small, moderately curved, 12–20 times as long as wide, inner margin slightly tumid, gradually attenuated to the acutely rounded apices; cell-wall colorless and smooth.

Length 133–153 μ; breadth 7–12.5 μ. (PLATE 5, FIGURE 10.)

MASSACHUSETTS: Reading! Randolph! Lake Watuppa, Fall River!

41. CLOSTERIUM LINEATUM Ehrenb.

Closterium lineatum Ehrenb. Infus. 96. *pl. 6. f. 8.* 1838. — Wolle, Desm. U. S. 43. *pl. 6. f. 16.* 1884. — W. & G. S. West, Brit. Desm. **1**: 181. *pl. 24. f. 1–5.* 1904.

Cells large, elongated, 15–30 times as long as wide, moderately curved, median portion straight, ends more curved and gradually attenuated to the broad, truncately rounded apices; cell-wall yellowish or reddish-brown, with 12–20 striae across the surface; zygospores usually double, each part ovoid, walls smooth.

Length 540–775 μ; breadth 19–50 μ; apices 6–9 μ; diameter of zygospore 78 μ. (PLATE 4, FIGURE 3.)

MAINE: Scarboro (*W. West*).

MASSACHUSETTS: Near Salem (*Bailey*); Misery Island, off Beverly! Stony Brook, Weston! Cedar Pond, North Falmouth! Lake Watuppa, Fall River!

RHODE ISLAND: Wainskut Pond, North Providence (*Bailey*); Nyatt!

41*a*. CLOSTERIUM LINEATUM COSTATUM Wolle

Closterium lineatum Ehrenb. var. *costatum* Wolle, F.-W. Alg. U. S. 25. *pl. 61. f. 3.* 1887; Desm. U. S. 45. *pl. 10. f. 3.* 1892. —Johnson, Bull. Torrey Club **21**: 286. 1894.

Cells with coarser and fewer costae.

NEW HAMPSHIRE: Rochester (*Wolle*).

CONNECTICUT: Bridgeport (*Johnson, W. & G. S. West*).

*42. CLOSTERIUM RALFSII Bréb.

Closterium Ralfsii Bréb. in Ralfs, Brit. Desm. 174. *pl. 30. f. 2.* 1848.— Wolle, Desm. U. S. 46. *pl. 7. f. 10.* 1884.— W. & G. S. West, Brit. Desm. **1**: 182. *pl. 24. f. 6, 7.* 1904.

Cells large, 8–10 times as long as broad, moderately curved, inner margin much inflated for over half the length of the cell, somewhat abruptly attenuated toward the ends, which are somewhat produced and incurved, apices obtuse; cell-wall yellowish or reddish-brown with about 30 striae visible across the surface.

Length 428–496 μ; breadth 52–54 μ; apices 10–12 μ.

MASSACHUSETTS: Lake Watuppa, Fall River!

RHODE ISLAND: Nyatt!

42*a*. CLOSTERIUM RALFSII HYBRIDUM Rabenh.

Closterium Ralfsii, var. *hybridum* Rabenh. Krypt.-Fl. Sachs. 174. 1863. — W. & G. S. West, Jour. Linn. Soc. Bot. **33**: 284. 1898; Brit. Desm. **1**: 183. *pl. 24. f. 8–13.* 1904.

Cells longer than the typical, 13–16 times as long as broad, ventral inflation less prominent, apices subtruncate.

Length 356–682 μ; breadth 24–53 μ; apices 6–15 μ. (PLATE 5, FIGURES 8, 9.)

NEW HAMPSHIRE: Pudding Pond, North Conway!

MASSACHUSETTS: Winchester! Reading! Randolph! Eastham!

CONNECTICUT: Bridgeport (*W. & G. S. West*).

*42*b*. **Closterium Ralfsii immane** var. nov.

Cells similar to *C. Ralfsii*, but larger, very tumid, about 9–11 times as long as wide, rather abruptly attenuated to the rounded apices; cell-wall yellow or reddish-brown, with 30–50 striae across the surface.

Length 610–806 μ; breadth 67–75 μ; apices 11–12 μ. (PLATE 4, FIGURE 4.)

MASSACHUSETTS: Lake Watuppa, Fall River!

43. CLOSTERIUM BRAUNII Reinsch

Closterium Braunii Reinsch, Algenfl. Frank. 196. *pl. 12. f. 5.* 1867. — W. & G. S. West, Trans. Linn. Soc. Bot. **II. 5**: 236. *pl. 13. f. 16, 17.* 1896.

C. areolatum Wood, F.-W. Alg. 111. *pl. 11. f. 6.* 1874.—Wolle, Desm. U. S. 43. *pl. 8. f. 3, 4.* 1884.

C. maculatum Hastings, Amer. Month. Micr. Jour. **13**: 154. *pl. 1. f. 5.* 1892.—Johnson, Bull. Torrey Club **22**: 291. *pl. 239. f. 7.* 1895.

Cells large, very slightly curved or straight, central portion straight, then rather abruptly attenuated to the broadly truncate ends; cell-wall yellowish or reddish-brown, with 10–20 striae or costae, each made up of a double row of elongated granules.

Length 622 μ; breadth 43–50 μ; apices 10–11 μ.

MAINE: Scarboro (*W. & G. S. West*).

CONNECTICUT: Bridgeport, rare (*Johnson*).

44. CLOSTERIUM INTERVALICOLA Cushman

Closterium intervalicola Cushman, Rhodora **7**: 115. *pl. 61. f. 1.* 1905.

Cells rather small, about 10–12 times as long as wide, median portion nearly straight, but the ends decidedly curved, very slightly attenuated to the squarely truncated apices; cell-wall yellowish-brown with about 6 coarse striae across the surface.

Length 168 μ; breadth 15.5 μ; apices 6 μ. (PLATE 5, FIGURE 5.)

NEW HAMPSHIRE: Intervale!

*45. **Closterium Novæ-Angliæ** sp. nov.

Cells large, very elongate, 30–35 times as long as wide, very slightly curved, median portion straight, gradually attenuated to the incurved ends, ventral margin slightly tumid for a large part of its course near the middle, apices obtusely rounded; cell-wall yellowish or reddish-brown with a thickening and consequent darkening at the apices, 6–8 striae across the surface changing to granules near the apices.

Length 930–1080 μ; breadth 28–30 μ; apices 9–11 μ. (PLATE 4, FIGURE 1.)

MASSACHUSETTS: Lake Watuppa, Fall River!

This is one of the longest species recorded for this genus, being exceeded slightly by *C. mourense* Playfair, which is however 3–4 times as wide. This is near *C. Calamus* Playfair.

46. CLOSTERIUM DECORUM Bréb.

Closterium decorum Bréb. Mém. Soc. Sci. Nat. Cherbourg **4**: 151. *pl. 2. f. 39.* 1856. — Wolle, Desm. U. S. 43. *pl. 7. f. 1.* 1884. — W. & G. S. West, Brit. Desm. **1**: 184. *pl. 17. f. 7, 8.* 1904.

C. Delpontei Wolle, Bull. Torrey Club **12**: 2. 1885; F.-W. Alg. U. S. 25. *pl. 55. f. 9.* 1887; Desm. U. S. 45. *pl. 6. f. 9.* 1892.

Cells large, 12–16 times as long as wide, median portion of inner margin tumid, outer margin moderately curved, gradually attenuated to the truncately rounded apices; cell-wall yellowish-brown, with 15–18 striae across its surface.

Length 325–540 μ; breadth 24–48 μ; apices 6–9 μ. (PLATE 4, FIGURE 2.)

MAINE: Scarboro (*W. West*).

NEW HAMPSHIRE: Pudding Pond, North Conway! North Woodstock!

MASSACHUSETTS: Halifax! Lake Watuppa, Fall River! Gay Head, Marthas Vineyard! Gibbs Pond, Nantucket!

CONNECTICUT: Bridgeport and Easton (*Johnson, W. & G. S. West*).

47. CLOSTERIUM KÜTZINGII Bréb.

Closterium Kützingii Bréb. *l. c.* 156. *pl. 2. f. 40.* 1856. — Wolle, Desm. U. S. 47. *pl. 8. f. 8.* 1884. — W. & G. S. West, Brit. Desm. **1**: 186. *pl. 25. f. 6–11.* 1904.

Cells of medium size, 18–26 times as long as broad, nearly straight, median portion of cell fusiform, both margins of about the same convexity, attenuated at each end into long colorless processes, apices slightly incurved, rounded and slightly enlarged; cell-wall colorless or light yellowish-brown with 10–15 striae visible across the cell.

Length 325–460 μ; breadth 13–22 μ; apices 2.5–3 μ. (PLATE 4, FIGURE 13.)

MAINE: Pushau Stream (*Harvey*).

NEW HAMPSHIRE: Pudding Pond, North Conway! Hills Pond, Alton!

MASSACHUSETTS: Winchester! Randolph! Bridgewater! Lake Watuppa, Fall River! Westport! Cedar Pond, North Falmouth!

48. CLOSTERIUM ROSTRATUM Ehrenb.

Closterium rostratum Ehrenb. Phys. Abh. Akad. Wiss. Berlin 67. 1833. — Wolle, Desm. U. S. 46. *pl. 8. f. 1–3.* 1884. — W. & G. S. West, Brit. Desm. **1**: 188. *pl. 26. f. 1–5.* 1904.

Cells of medium size, 14–18 times as long as wide, slightly curved, median portion fusiform, inner margin more convex than the outer, attenuated at each end into long slightly incurved processes, shorter than in the preceding, ends slightly enlarged; cell-wall yellowish-brown with 25 or more striae across the surface.

Length 360–420 μ; breadth 19–25 μ; apices 3–4.5 μ. (PLATE 4, FIGURE 14.)

MAINE: Between Orono and Bangor (*W. West*); Pushau Pond (*Harvey*).

MASSACHUSETTS: Amherst (*W. West*); Bridgewater! Pondville! Lake Watuppa, Fall River!

48a. CLOSTERIUM ROSTRATUM BREVIROSTRATUM West

Closterium rostratum, var. *brevirostratum* W. West, Jour. Roy. Micr. So. **1889**: 17. *pl. 2. f. 9.* 1889.—W. & G. S. West, Brit. Desm. **1**: 189. *pl. 26. f. 6–8.* 1904.

Cells with shorter and less attenuated apices.

MASSACHUSETTS: Amherst (*W. West*).

49. CLOSTERIUM SETACEUM Ehrenb.

Closterium setaceum Ehrenb. Infus. 97. *pl. 6. f. 9.* 1838. — Wolle, Desm. U. S. 47. *pl. 8. f. 6, 7, 9–11.* 1884. — W. & G. S. West, Brit. Desm. **1**: 190. *pl. 26. f. 9–13.* 1904.

Cells small, very slender, nearly straight, 35–45 times as long as wide, median portion fusiform, both margins equally convex, extremities prolonged, very slender; cell-wall colorless or slightly yellowish-brown, with about 12 or 13 fine striations across the surface; zygospore cruciform.

Length 235–465 μ; breadth 6–10 μ; apices 1–2.3 μ. (PLATE 4, FIGURES 15, 16.)

MAINE: Spencer Pond, East Middlesex!

NEW HAMPSHIRE: Pudding Pond, North Conway!

MASSACHUSETTS: Near Salem (*Bailey*); Reading! Randolph! Bridgewater, zygospores! Halifax! Lake Watuppa, Fall River! Nantucket!

RHODE ISLAND: Providence (*Bailey*); Nyatt!

The following forms of *Closterium* are not included in the above records:

"CLOSTERIUM DECUSSATUM Kg."

Recorded by Wolle from Gilder and other ponds on Mt. Everett, Mount Washington, Mass. What Wolle had is a perplexing thing, as I collected in Gilder Pond in 1907 and failed to find anything corresponding to many of the forms described by Wolle from that locality.

CLOSTERIUM NASUTUM Nordst.

Recorded by Wolle from "Ponds, Berkshire Mountains, Massachusetts." I have failed to find anything corresponding to this species.

CLOSTERIUM SUBANGUSTATUM West

This was described from Maine, "Bog between Orono and Bangor." It is close to some forms of *C. angustatum*, var. *clavatum* Hastings.

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Explanation of plates 3-5

PLATE 3

FIG. 1. *Closterium Cynthia* De Not. × 450.
" 2. " " " zygospore, × 450.

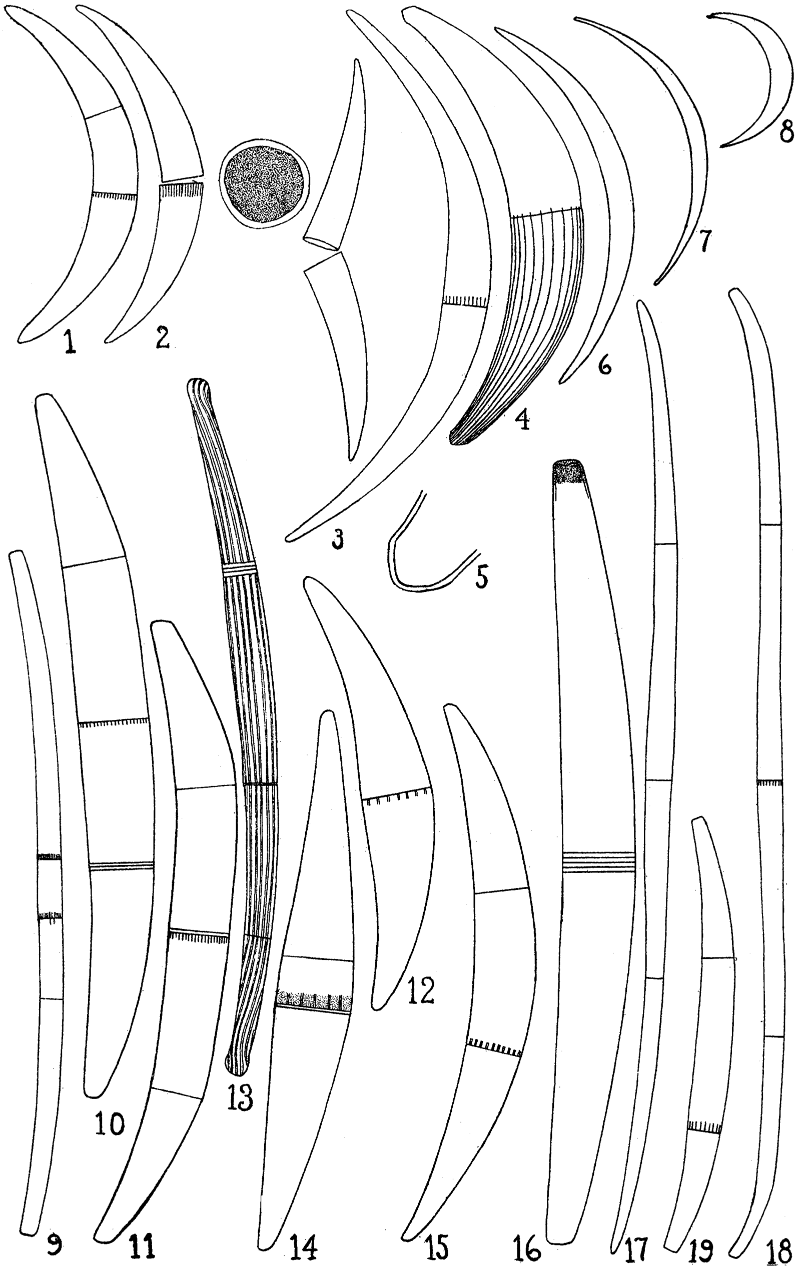
FIG. 3. *Closterium Archerianum* Cleve, × 350.
" 4. " *Malmei* Borge, × 200.
" 5. " " " apex, × 600.
" 6. " *parvulum* Näg. × 350.
" 7. " " " × 300.
" 8. " *incurvum* Bréb. × 300.
" 9. " *Ulna* Focke, × 350.
" 10. " *striolatum* Ehrenb. × 350.
" 11. " " *erectum* Klebs, × 350.
" 12. " *angustatum clavatum* Hastings, × 160.
" 13. " *costatum* Corda, × 250.
" 14. " " *Westii* Cushman, × 300.
" 15. " *regulare* Bréb. × 250.
" 16. " *didymotocum* Corda, × 350.
" 17. " *macilentum* Bréb. × 350.
" 18. " *juncidum* Ralfs, × 350.
" 19. " " *brevius* Roy, × 350.

PLATE 4

FIG. 1. *Closterium Novae-Angliae* sp. nov. × 125.
" 2. " *decorum* Bréb. × 350.
" 3. " *lineatum* Ehrenb. × 250.
" 4. " *Ralfsii immane* var. nov. × 225.
" 5. " *Pritchardianum* Arch. × 300.
" 6. " *acerosum elongatum* Bréb. × 150.
" 7. " *aciculare* T. West, × 250.
" 8. " *littorale* Gay, × 350.
" 9. " *Leibleinii* Kütz. × 300.
" 10. " *moniliferum* (Bory) Ehrenb. × 300.
" 11. " *Ehrenbergii* Menegh. × 250.
" 12. " *Dianae* Ehrenb. × 300.
" 13. " *Kützingii* Bréb. × 300.
" 14. " *rostratum* Ehrenb. × 300.
" 15. " *setaceum* " × 300.
" 16. " " zygospore, × 350.
" 17. " *Toxon* West, × 350.
" 18. " *Lunula* (Müll.) Nitzsch, × 125.

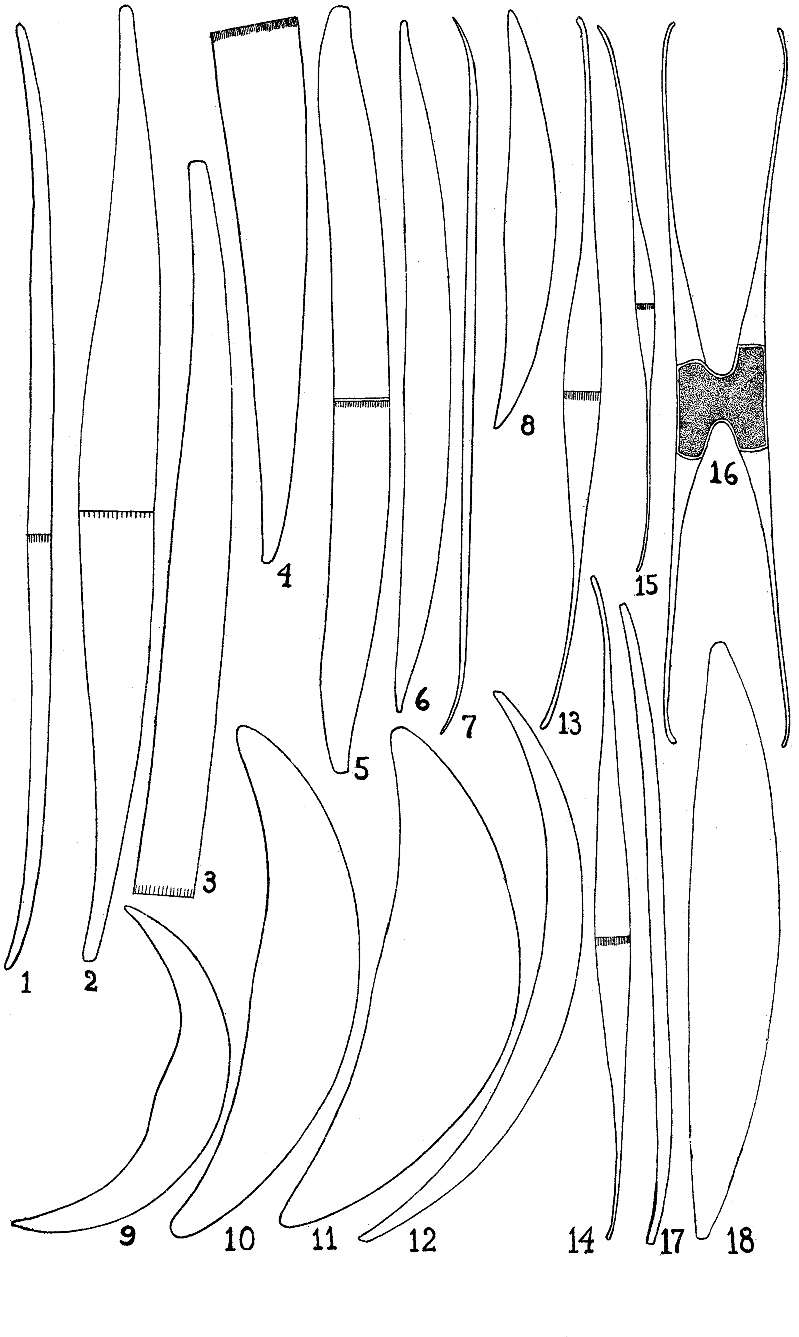
PLATE 5.

FIG. 1. *Closterium Pseudodianae* Roy, × 300.
" 2. " *Venus* Kütz. × 400.
" 3. " *Jenneri* Ralfs, × 350.
" 4. " " " × 450.
" 5. " *intervalicola* Cushman, × 300.
" 6. " *didymotocum* Corda, × 200.
" 7. " *Lunula maximum* Borge, × 125.
" 8. " *Ralfsii hybridum* Rabenh. × 150.
" 9. " " " " tip, × 450.
" 10. " *subulatum* (Kütz.) Bréb. × 450.
" 11. " *acutum* (Lyngb.) Bréb. × 400.
" 12. " *littorale* Gay, zygospore, × 400.



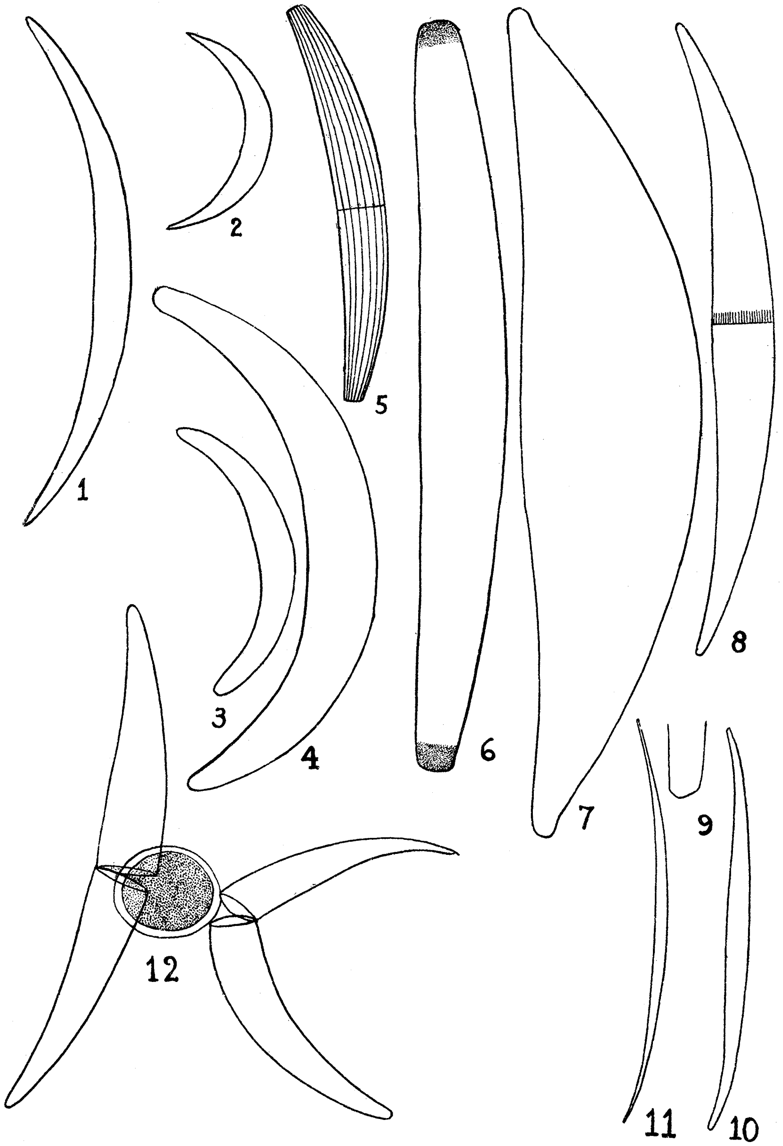
NEW ENGLAND SPECIES OF CLOSTERIUM

COCKAYNE, BOSTON



NEW ENGLAND SPECIES OF CLOSTERIUM

COCKAYNE, BOSTON



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